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Group 6
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NOVA SCOTIA
Nova Scotia Department of Agriculture

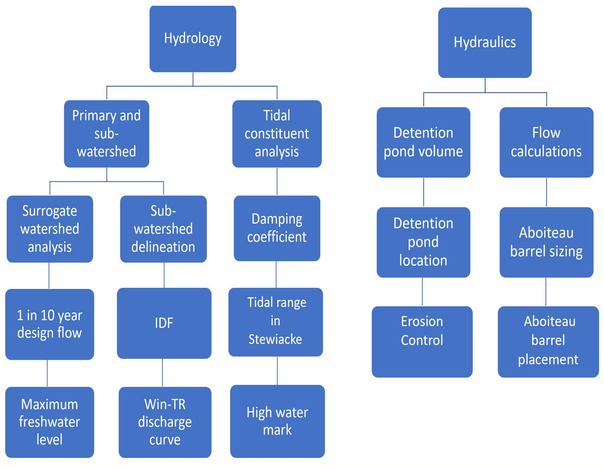
Preventing Tidal and Freshwater Flooding in Dykelands: Stewiacke, Nova Scotia, Canada

Scope of Work

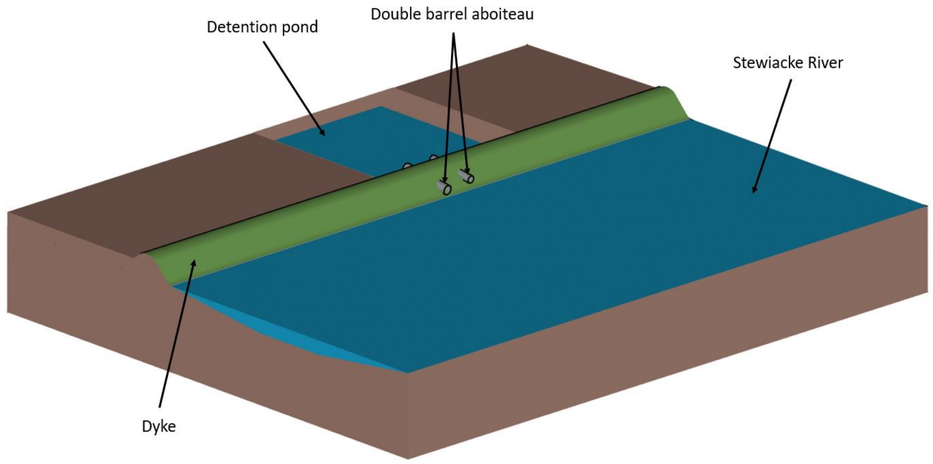
Stewiacke, Nova Scotia experiences reoccurring flooding along the Stewiacke River, impacting its recreational facilities. The flooding is caused by the tidally influenced river and lack of drainage for surface runoff. An aboiteau and detention pond were designed to prevent flooding on the landward side of the dyke, while using tidal cycle analysis to determine placement of the barrels.

Above: Project site location at current conditions

Design Process

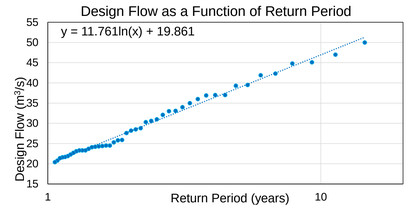


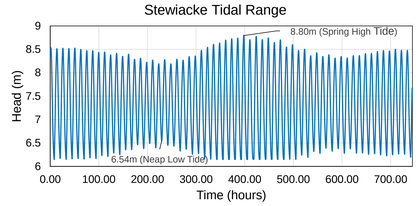
Design Model

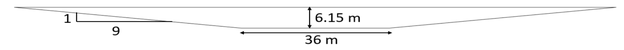


(SketchUp, 2022)

High Water Mark

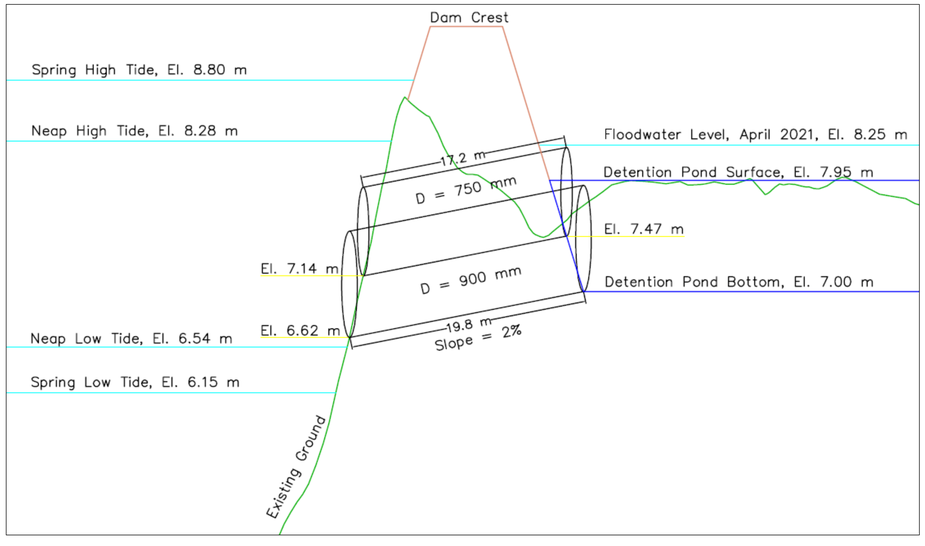




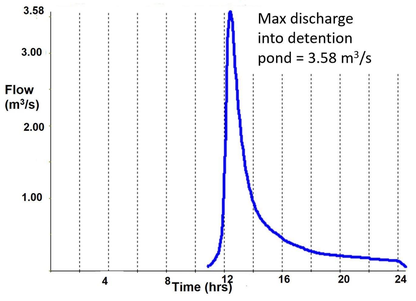


- Design flow was used in tandem with the cross section above to determine the highest freshwater level in the river.
- Freshwater flow condition: 6.15 m deep
- Design flow of 493 m^3/s
- Surrogate watershed (Rocklin, Pictou County) was used as a function of a 1-in-10-year return period.

Design Cross-Section

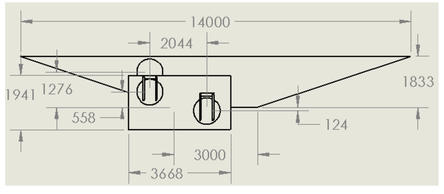


Sub-Watershed Hydrology



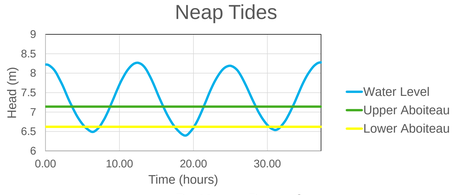
- Sub-watershed delineated using ArcGIS
- Area = 1.17 m^2
- Slope = 3%
- Travel time = 0.43 hrs, using Chow and Watt 1985
- Precipitation data predicted for year 2100 using IDF tool from Western University
- IDF tool used RCP 8.5 and CMIP5 climate models to generate worst case scenario precipitation events
- Sub-watershed divided by hydrologic surface classifications and entered into WIN-TR 55 along with watershed properties and precipitation data
- Maximum discharge = 3.58 m^3/s for 10 year, 5.25 hr precipitation event

Drainage Time



Top Barrel

- Diameter: 750 mm
- Downstream invert elevation: 7.14 m
- Flow frequency: 43.9%
- Longest duration closed: 7 hours
- Shortest duration open: 4.75 hours



Bottom Barrel

- Diameter: 900 mm
- Downstream invert elevation: 6.62 m
- Flow frequency: 25.2%
- Longest duration closed: 10 hours
- Shortest duration open: 1.25 hours

Conclusions and Recommendations

- Following thorough analyses of sub-watershed hydrology, river hydraulics, and tidal constituents, the detention requirements and drainage constraints were determined for this site. The detention pond was sized to detain a 10-year storm flow for the maximum duration that both aboiteaux are unable to drain. The aboiteaux were sized to drain this detention pond volume during the minimum drainage duration available (during a neap tidal cycle). This final design could be improved upon by accounting for the following considerations:
- Site-specific data collection is needed to provide accurate estimation and design.
- Sea-level rise should be considered in the Stewiacke River to determine a higher high-water mark. This can be done using hydrologic modelling in HEC-RAS.
- Historical precipitation alone cannot predict future rainfall events and should be paired with climate change modelling for accurate predictions.
- Erosion control is needed to avoid failure of the dyke and aboiteau.

References

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